# Team Critical Thinking: Foundations & Research Directions

TC3

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# Overview

- What is critical thinking?
- What is teamwork?
- What is team critical thinking?
- The role of collaboration technology in team critical thinking

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# What is Critical Thinking?

- Evaluating and improving understanding of
  - Cognitive products:
    - "Do I accurately recognize this problem?"
    - "Do I recall the correct solution?"
  - Cognitive process:
    - "Am I using the best method to solve this problem?"

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# What is a Team?

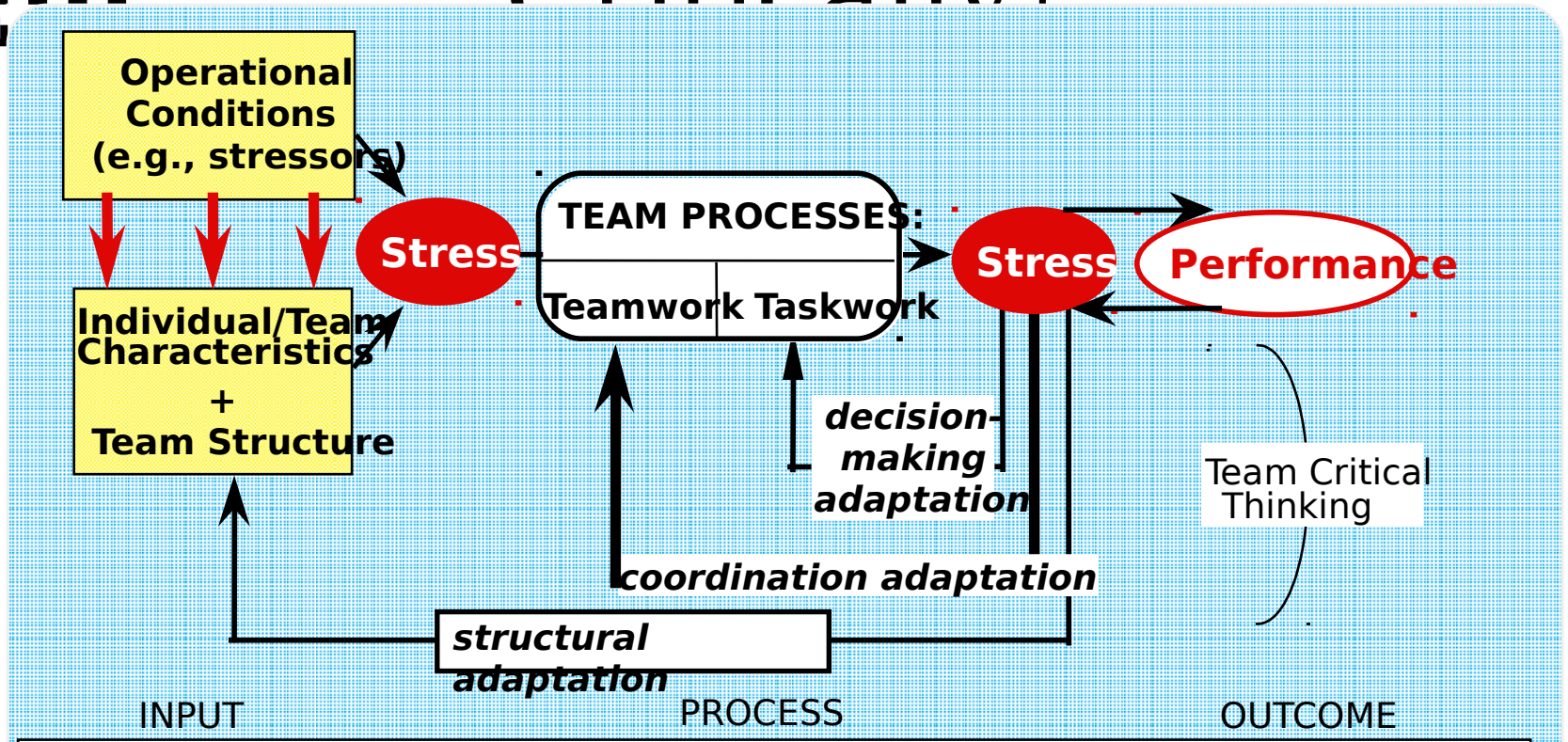
- An organization of individuals with different roles
- … who execute missions via:
  - Individual task work
  - Team coordination (management of overlap)
    - Explicit coordination: communication of information
    - Implicit coordination based on:
      - plans
      - direct observation of team mates
      - inference from observed events
  - Team structure (e.g., functional, divisional)

# What is Team Critical Thinking?

| | | Topic of Critical Thinking | | | |
|---|---|---|---|---|---|
| | | **Individual cognition** | **Team: Explicit coordination (communication)** | **Team: Implicit coordination** | **Team: Structure** |
| **Depth of Critical Thinking** | **Product** | What is the problem & solution? | What information to communicate to whom, when? (Information state & requirements) | What act of coordination is needed? (System state & requirements) | What team architecture is required? (System configuration) |
| | **Process** | How to improve the problem definition or solution? | How can communication be improved? (Protocols) | How can coordination be improved? (Procedures) | How can the team be transformed? (Adaptation procedures) |

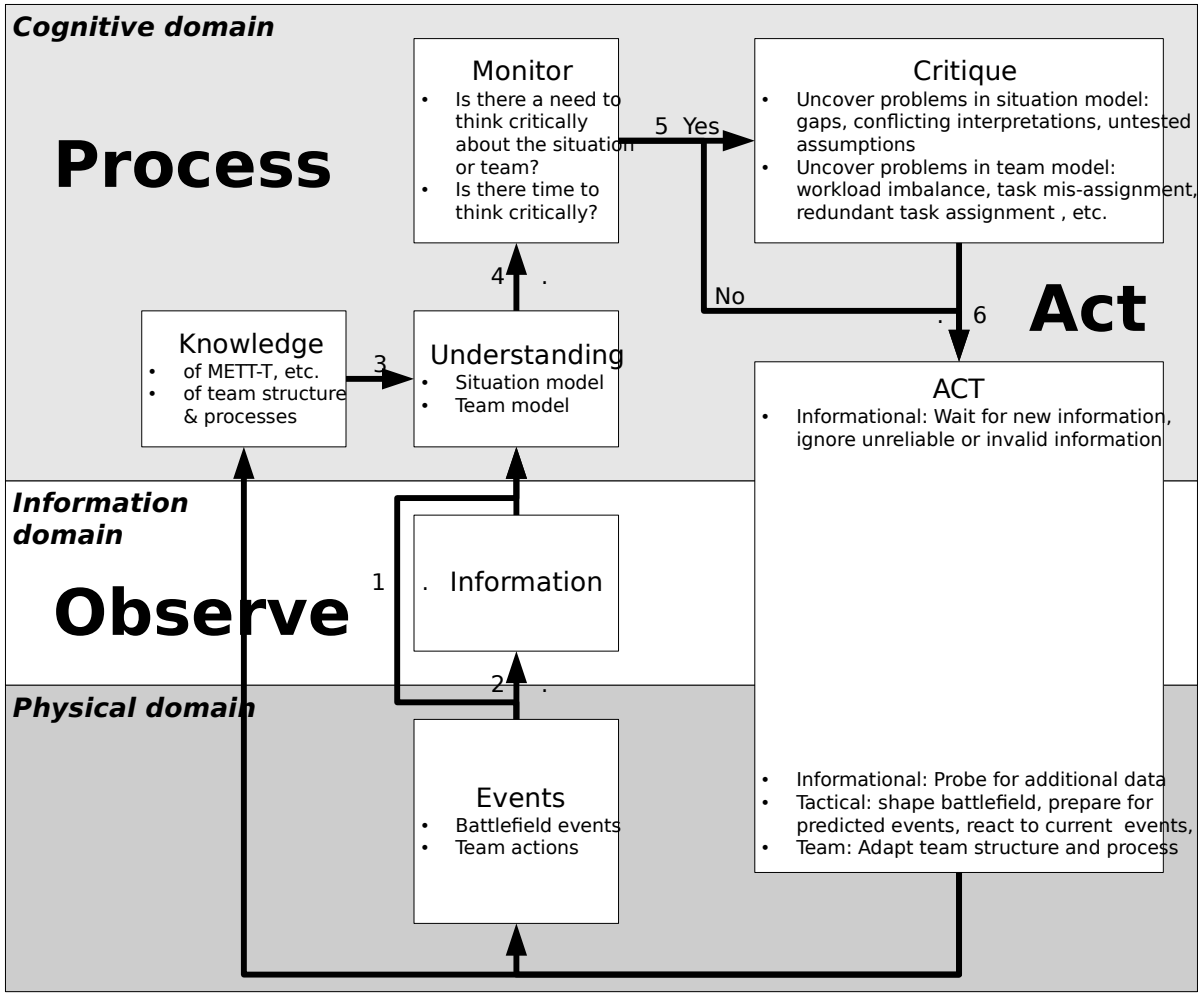
- Think critically about
  - Individual taskwork or teamwork
  - Products or processes

# When Do Teams Think Critically?




***PREMISE:** Well-trained teams cope with stress through internal mechanisms of decision strateg adaptation, coordination strategy adaptation, and structural reconfiguration, in an effort to kee performance at the required level while maintaining stress below an acceptable threshold.*

# How Do Teams Think Critically?



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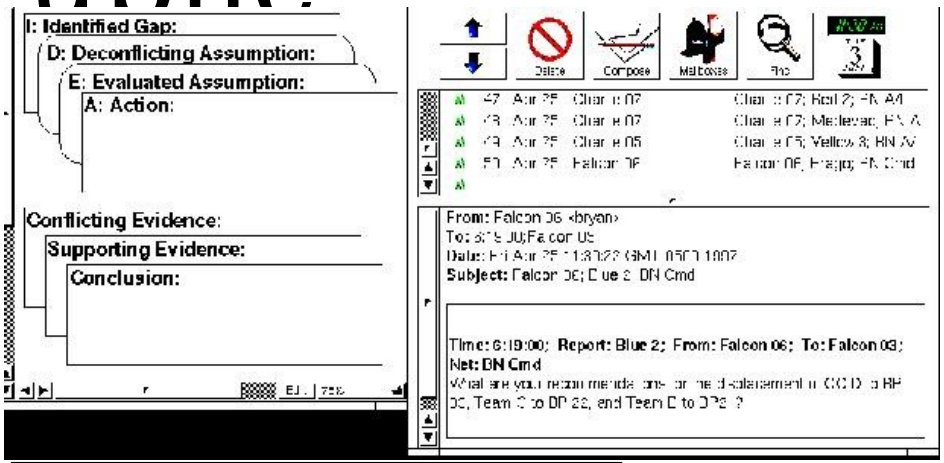
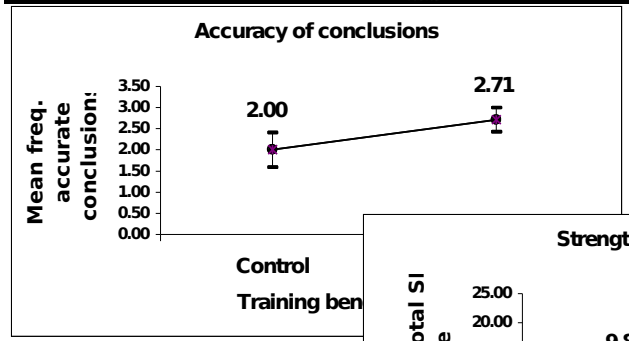
# Research Questions

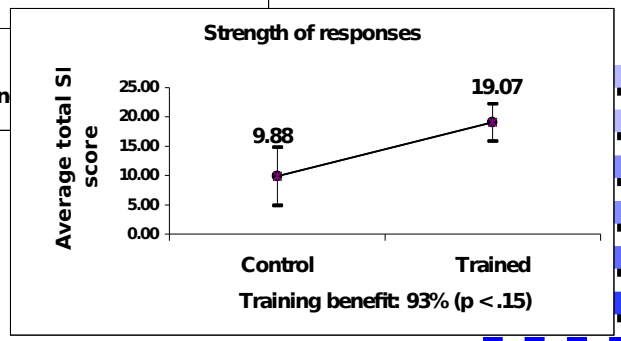
- How can we support team critical thinking?
  - Make cognitive products public
    - Orders, plans, …
  - Make cognitive processes public
    - Arguments (reasoning), causal models, stories, …
  - Help team members monitor, critique, and refine products & processes

# Evidence: Making Process Public

- H: Making COA analysis (process) explicit improves decisions & persuades
- Method: STIM (product + process) vs. text (mainly product) in dynamic re-planning task by 11 former Army officers
- Finding: STIM may improve
  - Accuracy of decisions
  - Persuasiveness
  - Use of information
  - Proaction, net discipline, filtering, data processing



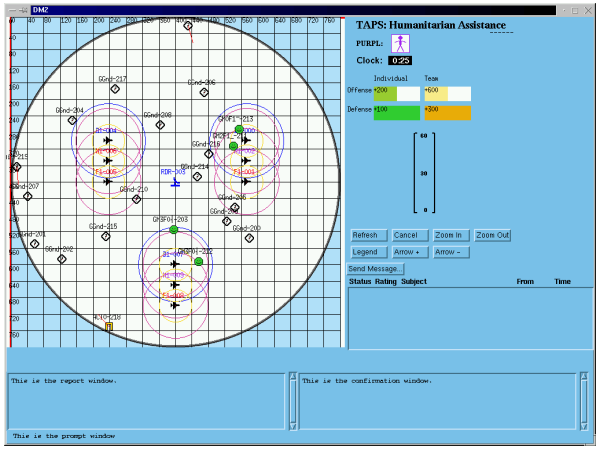




- Freeman, et al. (1997)

# Evidence: Making Process Public

- H: Team performance in low uncertainty task should benefit from functional (vs. divisional) architecture & e-whiteboard (vs. paper map)
- Method: 3-person teams plan humanitarian mission using whiteboard (process + product) vs. map (mainly product) & execute as divisional vs. functional team
- Findings: Accuracy reliably improves ($p < .05$) with functional structure & e-whiteboard

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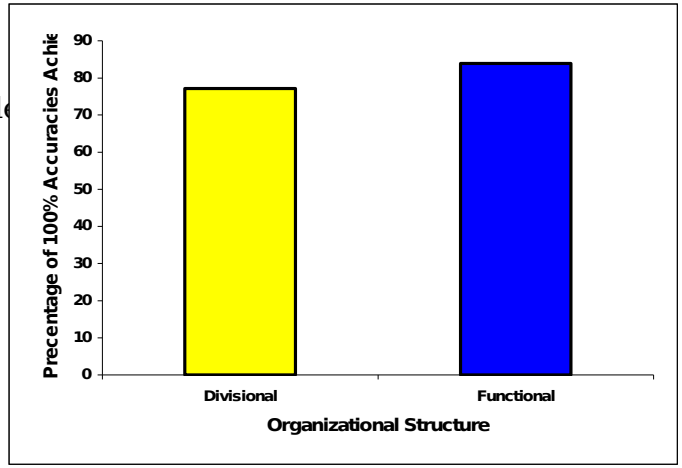
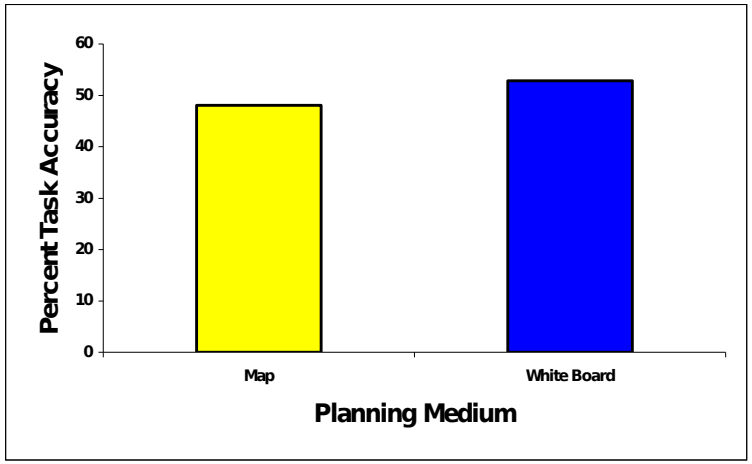
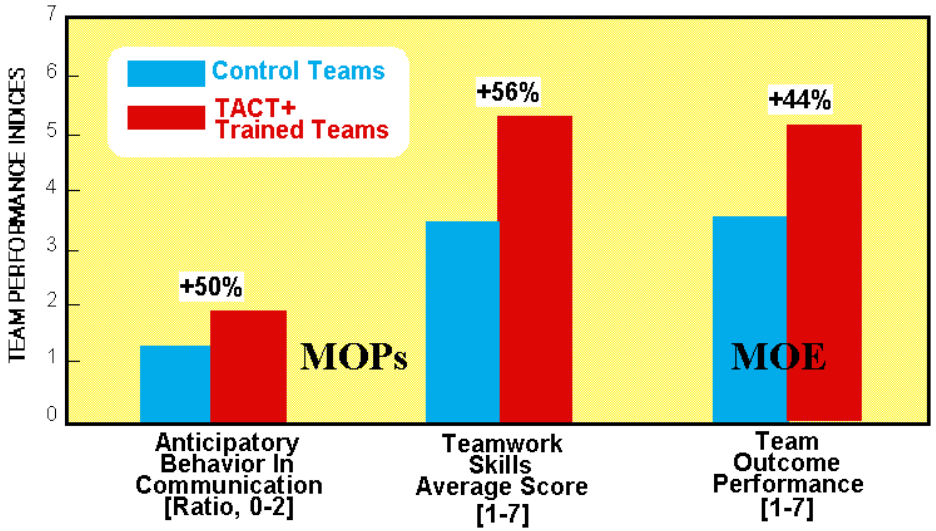


# Evidence: Making Process Public

- H: Team performance benefits from knowledge and control of teamwork processes.
- Method: 6 teams of 5 execute AAW scenario with(out) training in stress recognition, process adaptation, situation updates (TACT+)
- Findings: Knowledge & control of teamwork improves process & effects




- Entin & Serfaty (1999)

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# Research Questions

- How can we support team critical thinking?
  - Make cognitive products public – Common
  - Make cognitive processes public – Rare
- When should we make process public?
  - Multi-disciplinary teams & ad hoc teams – To expose contrasting problem-solving strategies & instill trust
  - Distributed team – To compensate for lack of direct observation of problem solving process

# Research Questions

- What knowledge (below), skills, & attitudes are required for TCT? By whom?
- What types of teams most benefit from TCT? What missions?
- When should TCT be exercised?
- What effects does TCT have on performance?

| | | Topic of Critical Thinking | | | |
|---|---|---|---|---|---|
| | | **Individual cognition** | **Team: Explicit coordination (communication)** | **Team: Implicit coordination** | **Team: Structure** |
| **Depth of Critical Thinking** | **Product** | Is my solution adequate? | What information do others have? What do they need? What channels do they use? | What requires coordination: member goals, resources, info, or tasks? | What team architecture is congruent with the mission? |
| | **Process** | Do I have time, opportunity, and need to refine my understanding or solution? How should I do so? | When should we push vs. pull info? | When does a change in the mission entail a new plan? A different mode of operation? | How can a team adapt its structure? How can it learn to do so better? How will organizational inertia manifest itself? |